REMARKS

This amendment is responsive to the Office Action mailed January 24, 2007. Reconsideration and allowance of claims 2-5, 7-11, 17, 18, 20-22, 24, 27, and 28 are requested.

The Latest Office Action

The present Office Action is the sixth Office Action on the merits, earlier Office Actions having been mailed on Aug. 13, 2004; Mar. 29, 2005; Sep. 20, 2005; Mar. 7, 2006; and Aug. 23, 2006.

The previously indicated allowance of claims 2, 4, 5, 7, 8, 10, 17, 18, 21, 22, 24, and 28, as well as the indication of allowable subject matter in claims 3, 9, and 11, have now been withdrawn, in favor of the following new rejections:

Claims 2-5, 10, 11, 17, 18, 20, 21, 27, and 28 now stand rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Chiao, U.S. Patent No. 6,048,315 (hereinafter "Chiao") in view of Gersheneld et al., U.S. Patent No. 5,914,701 (hereinafter "Gersheneld");

Claims 7-9 now stand rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Chiao in view of Gersheneld in further view of Nappholtz, U.S. Patent No. 5,113,869 (hereinafter Nappholtz);

Claim 22 now stands rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Chiao in view of Gersheneld in further view of Kinast, U.S. Patent No. 5,995,858; and

Claim 24 now stands rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Chiao in view of Gersheneld in further view of Abraham, U.S. Patent No. 6,407,987.

The Chiao and Gersheneld References

All claim rejections employ a proposed combination of Chiao and Gersheneld as the primary references. Chiao is newly identified in the sixth Office Action. Gersheneld is not listed in the "Notice of References Cited" attached with the sixth Office Action, but is believed to also be a newly identified reference.

Chiao relates to ultrasound imaging, and employs binary complementary pairs of sequences, including so-called "Golay sequences", to increase the signal-to-noise ratio (SNR) <u>without incurring undesirable range lobes</u>. Chiao col. 1 lines 7-10; col. 2 lines 55-61. The Office Action acknowledges:

> Chiao does not specifically disclose the transmitted and detected signals are spread spectrum signals. However, Chiao does disclose the transmitted and detected signals are Golay coded (see col. 2 lines 55-67), <u>wherein Golay codes are known in the art as spread spectrum codes</u>.

Office Action at page 4.

The Office Action provides absolutely no support for the underscored comment. The Office Action points to nothing on the record that remotely suggests that the skilled artisan would consider "Golay codes" to be equivalent to "spread spectrum".

Indeed, the cited portion of Chiao expressly contradicts this bald assertion, stating that the benefit of Golay sequences is that they increase the SNR <u>without incurring undesirable range lobes</u>. Such "undesirable range lobes" would constitute some sort of spreading of the spectrum – hence, Chiao itself teaches that Golay sequences do <u>not</u> spread the spectrum, and advocates the lack of such spectral spreading as an advantage of Golay sequences. A coding that produces a signal with extraneous lobes (that is, something other than a Golay sequence according to Chiao) would not necessarily be a spread spectrum signal, but at least would be in the direction of spreading the spectrum. The Golay sequences of Chiao do not even reach this level, but are instead expressly selected to avoid any spectral spreading.

Assertions of technical facts of specific knowledge of the prior art must always be supported by citation to some reference work recognized as standard in the pertinent art. MPEP § 2144.03. It is never appropriate to rely solely on "common knowledge" in the art without evidentiary support in the record, as the principal evidence upon which a rejection was based. *Id.* The unsupported equating of Chiao's "Golay coding" with "spread spectrum" is fundamental to the proposed basis of rejection, and cannot be properly made without providing evidentiary support. That Chiao teaches away from the relied-upon presumption heightens the discord between the Office Action's bald assertion and the teachings of Chiao.

The Wikipedia definitions of binary and ternary Golay codes are included herewith as definitional information respecting the term "Golay codes".

Gersheneld relates to use of small currents externally induced in people by electrostatic field coupling for sensing a person's position for use in control tasks. Gersheneld employs spread spectrum signals for this purpose (col. 2 lines 20-25). However, Gersheneld is wholly unrelated to measuring a physiological condition, and does not disclose or fairly suggest generating a measured parameter signal that is analyzed to measure a physiological condition. At most, Gersheneld discloses the concept of spread spectrum transmission, a concept which has already been acknowledged by Applicants on the record to be known.

Taken together, the proposed combination of Chiao and Gersheneld merely discloses what was already on the record, namely that physiological measurements are known (e.g., ultrasound as taught by Chiao, or ultrasound as taught by Feldman which was previously cited at least in the March 7, 2006 Office Action) and that spread spectrum is known (e.g., as taught by Gersheneld, or by Kadin or Abraham which were previously cited at least in the March 7, 2006 Office Action).

The newly proposed combination is improper at least because Chiao teaches away from using a signal that is intentionally spread out. *See* MPEP §§ 2141.02, 2145. Moreover, the suggestion that increasing noise immunity provides motivation for substituting Gersheneld's spread spectrum for the Golay coding used in the ultrasound of Chiao (Office Action at page 4) is rebutted because Chiao already teaches a satisfactory method of noise immunity via the Golay sequences. These Golay sequences increase the signal-to-noise ratio (thus enhancing noise immunity) <u>without</u> incurring spectral broadening in the form of undesirable range lobes. The proposed substitution of Gersheneld's spread spectrum for Chiao's Golay sequences would not enhance Chiao's noise immunity, and further would detrimentally introduce undesirable spectral broadening.

CONCLUSION

It is submitted that the claims patentably distinguish over the references of record including the newly cited Chiao and Gersheld references. It is further submitted that all claims meet the statutory requirements and are otherwise in condition for allowance. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he is requested to telephone the undersigned at (216) 861-5582.

Respectfully submitted,

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Binary Golay code

From Wikipedia, the free encyclopedia

In mathematics and computer science, a **binary Golay code** is a type of error-correcting code used in digital communications. The binary Golay code, along with the ternary Golay code, has a particularly deep and interesting connection to the theory of finite sporadic groups in mathematics. The code is named in honour of Marcel J. E. Gola

There are two closely related binary Golay codes. The **extended binary Golay code** encodes 12 bits of data in a 24-l word in such a way that any triple-bit error can be corrected and any quadruple-bit error can be detected. The other, t **perfect binary Golay code**, has codewords of length 23 and is obtained from the extended binary Golay code by deleting one coordinate position (conversely, the extended binary Golay code is obtained from the perfect binary Gol code by adding a parity bit).

Contents

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How Golay codes are transmitted

It is possible to send standard 8-bit bytes using this standard Golay code via using 8-to-12 modulation. Other bit allocation schemes may be used to allow 8-bit data to share bandwidth with 4-bit telemetry.

Mathematical definition

In mathematical terms, the extended binary Golay code consists of a 12-dimensional subspace W of the space $V=\mathbf{F}_2^{2}$ of 24-bit words such that any two distinct elements of W differ in at least eight coordinates. Equivalently, any non-ze element of W has at least eight non-zero coordinates.

- The possible sets of non-zero coordinates as w ranges over W are called *code words*. In the extended binary Golay code, all code words have Hamming weight 0, 8, 12, 16, or 24.
- Up to relabelling coordinates, W is unique.

The perfect binary Golay code is a perfect code; that is, the spheres of radius 3 around code words form a partition o the vector space.

The automorphism group of the binary Golay code is the Mathieu group M_{23}. The automorphism group of the extended binary Golay code is the Mathieu group M_{24}. The other Mathieu groups occur as stabilizers of one or seve elements of W.

The Golay code words are elements of the S(5,8,24) Steiner system.

Constructions

1. Lexicographic code: Order the vectors in V lexicographically (i.e., interpret them as unsigned 24-bit binary integers and take the usual ordering). Starting with $w_1 = 0$, define $w_2, w_3, ..., w_{12}$ by the rule that w_n is the smallest integer which differs from all linear combinations of previous elements in at least eight coordinates. Then W can be defined as the span of $w_1, ..., w_{12}$.
2. Quadratic residue code: Consider the set N of quadratic non-residues (mod 23). This is an 11-element subset of the cyclic group **Z**/23**Z**. Consider the translates $t+N$ of this subset. Augment each translate to a 12-element set by adding an element ∞. Then labelling the basis elements of V by 0, 1, 2, ..., 22, ∞, W can be defined as the sp of the words S_t together with the word consisting of all basis vectors. (The perfect code is obtained by leaving ∞.)
3. As a Cyclic code: The perfect G_{23} code, can be constructed via factorisation of $x^{23} - 1$, it is the code generat by $x^{11} + x^{10} + x^6 + x^5 + x^4 + x^2 + 1 / x^{23} - 1$
4. The "Miracle Octad Generator" of R. T. Curtis: This uses a 4×6 array of square cells to picture the 759 Hamming-weight-8 code words, or "octads," of the extended binary Golay code. The remaining code words ar obtained via symmetric differences of subsets of the 24 cells-- i.e., by binary addition. For details, see geometr of the 4×4 square.
5. Winning positions in the mathematical game of Mogul: a position in Mogul is a row of 24 coins. Each turn consists of flipping from one to seven coins such that the leftmost of the flipped coins goes from head to tail. T losing positions are those with no legal move. If heads are interpreted as 1 and tails as 0 then moving to a codeword from the extended binary Golay code guarantees it will be possible to force a win.

Practical applications of Golay Codes

NASA Deep Space Missions

The Voyager 1 & 2 spacecraft needed to transmit hundreds of color pictures of Jupiter and Saturn in their 1979 and 1980 fly-bys within a constrained telecommunications bandwidth.

- Color image transmission required 3 times the amount of data, so the Golay (24,12,8) code was used.
- This Golay code is only 3-error correcting, but it could be transmitted at a much higher data rate.

ALE HF Data Communications

The new US government standards for automatic link establishment (ALE) in High Frequency (HF) radio systems specifies the use of an extended (24,12) Golay block code for forward error correction (FEC).

- The Extended (24,12) Golay Code specified is a (24,12) block code.
- This code encodes 12 data bits to produce 24-bit code words.
- It is furthermore a systematic code, meaning that the 12 data bits are present in unchanged form in the code wo

The minimum Hamming distance between any two code words (the number of bits by which any pair of code words differs) is 8, giving this code the power to detect up to 7 errors in each code word (and correct none), correct up to 3 while detecting 4, or any intermediate combination.

- These modes may be listed as (0,7), (1,6), (2,5), and (3,4), where the first number indicates the number of error which may be corrected, and the second the number of errors which will be detected by each mode.

See also

- Mathieu group
- Steiner system
- Leech lattice

References

- Curtis, R. T. A new combinatorial approach to M_{24}. Math. Proc. Camb. Phil. Soc. **79** (1976) 25-42.
- Griess, Robert L.: "Twelve Sporadic Groups", Springer-Verlag, 1998.
- Thompson, Thomas M.: "From Error Correcting Codes through Sphere Packings to Simple Groups", Carus Mathematical Monographs, Mathematical Association of America, 1983.

Category: Error detection and correction

Ternary Golay code

From Wikipedia, the free encyclopedia

There are two closely related error-correcting codes known as **ternary Golay codes**. The code generally known simp as the **ternary Golay code** is a perfect (11, 6, 5) ternary linear code; the **extended ternary Golay code** is a (12, 6, 6) linear code obtained by adding a zero-sum check digit to the (11, 6, 5) code.

The complete weight enumerator of the extended ternary Golay code is

$$x^{12} + y^{12} + z^{12} + 22(x^6y^6 + y^6z^6 + z^6x^6) + 220(x^6y^3z^3 + y^6z^3x^3 + z^6x^3y^3).$$

The perfect ternary Golay code can be constructed as the quadratic residue code of length 11 over the finite field $\mathbf{F}_3$.

The automorphism group of the extended ternary Golay code is $2.M_{12}$, where M_{12} is a Mathieu group.

Consider all codewords of the extended code which have just six nonzero digits. The sets of positions at which these nonzero digits occur form the Steiner system S(5, 6, 12).

References

- J. H. Conway and N. J. A. Sloane. *Sphere Packings, Lattices and Groups*, Springer-Verlag, New York, Berlin, Heidelberg, 1988.
- Griess, Robert L.: "Twelve Sporadic Groups", Springer-Verlag, 1998.